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Tests of Species and Varieties of Vetch For Resistance to the Vetch Bruchid

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CONTENTS

	Page		Page
Introduction.....	1	Discussion.....	4
Method of procedure.....	1	Summary.....	5

INTRODUCTION

After the discovery of the vetch bruchid (*Bruchus brachialis* Fahr.), also called the vetch weevil, in the seed of hairy vetch (*Vicia villosa* Roth) along the middle Atlantic seaboard, studies on the biology of this insect were undertaken in 1935 by the Bureau of Entomology and Plant Quarantine of the United States Department of Agriculture. Because no satisfactory method of controlling the vetch bruchid has yet been developed it was felt that the discovery of a vetch that is not subject to attack by it and at the same time is agronomically suitable for production in the Southeastern States would provide a way to reduce the annual damage inflicted by this insect to the vetch seed crop. One phase of these investigations was therefore concerned with resistance of various species of vetch to the insect.

The importance of several species of vetch in different sections of the United States and their possible infestation by the bruchid also makes the results of these studies of general interest. The information presented was obtained from variety plantings made at Statesville, N. C., where they were exposed to heavy infestation.

METHOD OF PROCEDURE

The tests of species and varieties of vetch for possible resistance to the vetch bruchid were initiated in 1936 with the planting of 5 rows

of *Vicia villosa*, each planted with seed originating from a different State or country, and 1 row of each of 8 other species of vetch. In the next 2 years only 1 row of each species was planted. Each row was 16½ feet long. In all 3 years daily egg counts were made by selecting 50 pods at random on each row and counting the number of eggs observed thereon. At the end of the growing season the pods were taken from each row and the seed threshed out, put in cloth sacks, and brought into the laboratory for the issuance of any adults that might be present in the seed. Late in the fall each lot was examined and the percentage of infested seed and the number of infested seeds that produced adults were recorded.

During 1937 and 1938 two types of observations were conducted to determine the degree of resistance to attack by the bruchid, (1) the daily egg count on each row and (2) cage experiments to ascertain if possible whether the vetch bruchid would attack apparently resistant species of vetch when confined on them alone.

For the second type of observations the cages were constructed of cheesecloth stretched over wooden frames 3 by 4 by 3 feet high. One cage was placed over a section of each row of the species under observation, except where there was an insufficient stand to permit carrying on the experiment. Adults were introduced into each cage and confined on the plants during the period of formation and maturing of the seed pods. When the pods were mature all those produced in each cage were threshed and the seed put into a cloth sack and

TABLE 1.—Summary of oviposition by *Bruchus brachialis* on various species and varieties of vetch grown in the field, Statesville, N. C.

Species, variety, and source of seed	Common name	1936			1937			1938		
		Total pods examined	Total period of observation	Total eggs	Total pods examined	Total period of observation	Total eggs	Total pods examined	Total period of observation	Total eggs
		No.	Da.	No.	No.	Da.	No.	No.	Da.	No.
<i>Vicia villosa</i> (Oregon).....	Smooth or hairy vetch.....	956	20	757						
<i>V. villosa</i> (Latvia).....	do.....	1,014	22	213						
<i>V. villosa</i> (Sweden).....	do.....	1,210	25	414						
<i>V. villosa</i> (Hungary).....	do.....	1,479	31	1,298						
<i>V. villosa</i> (North Carolina).....	do.....	1,200	24	785	899	20	2,947	2,185	46	6,466
<i>V. ludoviciana</i> Nutt.....	Louisiana vetch.....	1,000	21	0	55	15	0	1,328	29	0
<i>V. sativa</i> L.....	Common vetch.....	1,462	30	1	1,138	27	0	2,515	56	2
<i>V. dasycarpa</i> Ten.....	Woollypod vetch.....	1,166	25	461	1,038	23	3,390			
<i>V. ervilia</i> (L.) Willd.....	Bitter vetch.....	960	20	0	1,013	29	0			
<i>V. pannonica</i> Crantz.....	Hungarian vetch.....	1,615	33	3	1,238	30	3	2,511	51	10
<i>V. monantha</i> (L.) Desf.....	Monantha vetch.....	1,375	28	0	271	21	0			
<i>V. atropurpurea</i> Desf.....	Purple vetch.....	(1)			935	20	65	2,046	42	239
<i>V. grandiflora</i> Scop.....					1,511	38	0	1,650	33	0
<i>V. angustifolia</i> L.....	Narrowleaf vetch.....	(2)			1,266	30	0			
<i>V. hircanica</i> Fisch. and Mey.....								1,331	27	0
<i>V. tetrasperma</i> (L.) Moench.....	Fourseed vetch.....							1,184	24	0
<i>V. hybrida</i> L.....								1,087	41	0
<i>V. noeana</i> Boiss.....								1,292	28	0
<i>V. melanops</i> Sibth. and Sm.....								1,352	29	8
<i>V. lutea</i> var. <i>hirta</i> Loisel.....								1,550	31	0
<i>V. lutea</i> L.....								1,821	41	0
<i>V. serratifolia</i> (Ser.) Jacq.....								2,780	58	0
<i>Lathyrus hirsutus</i> L.....	Rough Pea.....							1,150	23	0

¹ Winter-killed.

² All but 1 plant of this species was winter-killed and no observations were made on it. Records were kept on this species in various fields in Rowan and Iredell Counties, however, although no eggs were found throughout the entire period of oviposition.

brought into the laboratory for the recovery of any bruchids that might be present. These samples were examined late in the fall and the percentage of infested seed recorded, as well as the number of infested seeds producing adults.

The oviposition records are presented in table 1, and the results of the fall examination of the seed samples taken from the rows both inside and outside the cages are summarized by years in tables 2 and 3. As may be seen from these tables, the smooth type of *Vicia villosa* grown from North Carolina seed was used as a susceptible check during all 3 years. Other susceptible species were dropped out and other species added from year to year in the case of the oviposition tests.

TABLE 2.—Field infestation of vetch seed by the vetch bruchid, Statesville, N. C.

1936							
Row No.	Species and origin	Date of first blossoms	Date of first pods	Date of harvest	Seeds-ex- amined	Seeds in- fested	Seed produc- ing adults
					Number	Percent	Percent
A-4	<i>Vicia sativa</i>	May 9	May 13	June 11	378	0.12	0
A-5	<i>V. dasycarpa</i>	May 4	May 12	June 6	315	15.37	34.00
A-6	<i>V. villosa</i> (Oregon).....	May 6	May 13	June 4	3,859	19.43	79.61
A-8	<i>V. villosa</i> (Latvia).....	May 9	May 14	June 6	902	6.76	91.80
A-9	<i>V. pannonica</i>	May 4	May 11	June 12	1,200	.13	0
A-10	<i>V. villosa</i> (Sweden).....	Apr. 28	do	June 8	2,140	6.42	93.02
A-12	<i>V. villosa</i> (North Carolina) (check).....	May 4	May 14	June 10	1,859	23.77	89.56
A-13	<i>V. atropurpurea</i>	(¹)					
A-14	<i>V. dasycarpa</i>	Apr. 28	May 11	June 8	850	11.30	44.80
A-15	<i>V. villosa</i> (Hungary).....	May 4	do	June 3	2,354	16.50	87.20
1937							
1	<i>V. atropurpurea</i>	May 15	May 27	June 21	200	1.50	33.33
5	<i>V. dasycarpa</i>	Apr. 27	May 19	June 14	200	38.00	80.26
10	<i>V. villosa</i> (North Carolina) (check).....	May 4	do	June 10	200	52.50	91.43
1938							
E-1A	<i>V. villosa</i> (North Carolina) (check).....	Apr. 22	May 3	June 24	200	69.50	84.80
E-7A	<i>V. atropurpurea</i>	May 4	May 11	do	200	2.50	0

¹ Winter-killed.

TABLE 3.—Infestation by the vetch bruchid of seed from vetch plants covered by cages

1937				
Row No.	Species	Seed examined	Seed infested	Infested seed producing adults
		Number	Percent	Percent
1	<i>Vicia atropurpurea</i>	200	1.00	0
5	<i>V. dasycarpa</i>	200	39.50	86.10
10	<i>V. villosa</i> (check).....	200	81.50	94.50
1938				
E-1A	<i>V. villosa</i> (check).....	200	64.50	90.60
E-2A	<i>V. sativa</i>	200	.50	0
E-7A	<i>V. atropurpurea</i>	1100	1.00	0

¹ All the seed available.

DISCUSSION

During the course of these investigations 18 species of vetch and 1 of *Lathyrus* were tested in the nursery for susceptibility to attack by the vetch bruchid. Native Carolina vetch (*Vicia caroliniana* Walt.) was never included in the row plantings, as from field collections made in 1936 it was definitely ascertained that this species was attacked by the bruchid and that adults matured in the seed. Consequently this species is included with the other susceptible species here listed. Only 3 other species of vetch were definitely susceptible to attack by the weevil.

The heavily or moderately infested species in the seed of which weevils matured were the following:

	Common name		Common name
<i>Vicia villosa</i> -----	Smooth or hairy vetch.	<i>V. atropurpurea</i> -----	Purple vetch.
<i>V. dasycarpa</i> -----	Woollypod vetch.	<i>V. caroliniana</i> -----	Native Carolina vetch.

Species receiving a few eggs on pods but in the seed of which no weevils matured were as follows:

	Common name		Common name
<i>V. sativa</i> -----	Common vetch.	<i>V. melanops</i> -----	
<i>V. pannonica</i> -----	Hungarian vetch.		

These species were not infested by any stage of the weevil:

	Common name		Common name
<i>V. ludoviciana</i> -----	Louisiana vetch.	<i>V. hybrida</i> .	
<i>V. ervilia</i> -----	Bitter vetch.	<i>V. noeana</i> .	
<i>V. monanthos</i> -----	Monantha vetch.	<i>V. lutea</i> .	
<i>V. angustifolia</i> -----	Narrowleaf vetch.	<i>V. lutea</i> var. <i>hirta</i> .	
<i>V. grandiflora</i> -----	Grandiflora vetch.	<i>V. serratifolia</i> .	
<i>V. hyrcanica</i> .		<i>Lathyrus hirsutus</i> ---	Rough Pea.
<i>V. tetrasperma</i> -----	Fourseed vetch.		

Vicia melanops was tested only 1 year and on account of a poor stand was not given the cage test that was given the other species. In the 1 year of observation, however, only eight bruchid eggs were deposited upon its pods and no adults ever developed within the seed taken from the attacked pods.

During the period of observation *Vicia villosa* (from North Carolina) had 10,198 eggs deposited upon its pods, *Vicia dasycarpa* received 3,851 eggs, and *Vicia atropurpurea* received 304 eggs, while *Vicia sativa* had 3 eggs deposited upon it, *Vicia pannonica* 16 eggs, and *Vicia melanops* 8 eggs. When the total egg deposition on these last 3 species is compared with that of the 3 definitely susceptible species, it will be readily seen that there is a great disparity in the intensity of the oviposition on them.

The species of vetch which were not attacked by the weevil are not entirely adapted to the regions where *Vicia villosa* has become established. Certain of the species not attacked can be substituted to advantage, under conditions to which they are adapted, when infestation makes it impracticable to obtain seed of *V. villosa*. Common vetch (*V. sativa*) is adapted to well drained land of good fertility in the regions where the winter temperature does not go below 10° F. Hungarian vetch (*V. pannonica*) can be grown on the poorly drained soils under winter temperatures similar to those required for common vetch, and also in colder regions by spring seeding. The other vetch

species are adapted to specialized conditions and cannot often be used to replace those infested by the weevil. As *V. villosa* is hard to replace by any other species on sandy and alkali soils of low fertility, such as compose a large portion of the regions in the United States where vetch is grown, it is highly desirable that an acceptable variety be developed which will be resistant or immune to bruchid infestation. The bruchid damages only the seed and is thus a problem to the grower only from the standpoint of an economical seed supply.

The weevil infestations recorded in table 1 indicate the possibility of considerable variation between strains of *Vicia villosa* from different sources. Those from North Carolina, Oregon, and Hungary were considerably more heavily infested than those from Latvia and Sweden. As this test was on small unreplicated plots, these results can only point toward the possibility of selecting a resistant variety.

SUMMARY

Observation made at Statesville, N. C., during 1936, 1937, and 1938 on plantings of different species and varieties of vetch, both in open field conditions and under cages, with exposure to high populations of the vetch bruchid (*Bruchus brachialis*) in all cases, showed that heavy infestations resulted in the following four species: *Vicia villosa*, *V. dasycarpa*, *V. atropurpurea*, and *V. caroliniana*.

A few eggs were deposited on *Vicia sativa*, *V. pannonica*, and *V. melanops*, but no bruchid adults matured in the seed in the course of the investigations.

Twelve other species of *Vicia* and *Lathyrus hirsutus* were tested in the same experiments, but no eggs were deposited on them.

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